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XX. *Experimental Examination of Platina.*
By William Lewis, M.B. F.R.S.

P A P E R VI.

Experiments of distinguishing and purifying Gold mixed with Platina.

i. *By Amalgamation with Mercury.*

Read Mar. 31, 1757. IN an experiment related in the fourth paper, an amalgam of one part of platina and two of gold with a suitable quantity of mercury, having been triturated with water for a considerable time, and occasionally washed over, the platina was gradually thrown out, and the gold retained by the quicksilver.

Repetitions of this experiment have shewn, that tho' the separation succeeds in some cases, it does not perfectly in all: that if there is any particle of the platina imperfectly dissolved in the gold (which will generally be the case, unless the quantity of gold is three or four times greater than that of the platina), this part will be retained, after long trituration, undissolved by the mercury, uncommunited by the pestle, and too ponderous to be washed off in its gross form. A variety of mixtures of platina and gold were treated in the manner above described; and the gold, recovered from the amalgams, submitted to further examinations. Where the proportion of platina was large, the microscope almost always discovered still some granules of it on the fracture of the

the ingot: where the proportion was small, the recovered gold was frequently, but not constantly, found to be pure.

From these experiments it appears, that mercury has a greater affinity with gold than platina, and that platina is capable of being totally separated by elutriation; but that the process is too vague and undetermined to be applicable in the way of assay, as we have no mark of the precise time for discontinuing it, and as we can never be certain, without making another assay, whether the whole of the platina is separated or not. As a preparatory examination, where the quantities of platina and gold to be separated are large, it is nevertheless of good use, as greatest part of the platina may by this means be washed over with little trouble, and the gold brought into a less compass, so as to be commodiously submitted to a perfect purification by the means hereafter pointed out. This process has a similar effect on platina and gold to that of stamping and washing on metallic ores; which could not be reduced into pure metal in the furnace to advantage, without the previous separation of great part of the earthy and stony matter by water.

2. *By Precipitation with Alkalies.*

Gold is precipitated totally by fixed alkaline salts, but platina only in part. When solutions of the two metals are mixed together, so much of the platina remains suspended, after saturation with the alkali, as to be readily distinguishable by the yellow colour, which it communicates to the liquor. It has been objected,

objected, that tho' the platina was discoverable, when thus mingled superficially with the gold, it may nevertheless, when combined more intimately by fusion, elude this method of trial.

1. Mixtures of gold with small proportions of platina were therefore kept in fusion, by a very strong fire, for several hours, and afterwards dissolved in aqua-regis. The solutions being diluted with water, and a pure fixed alkaline salt gradually added, so long as any effervescence or precipitation ensued, the liquors remained manifestly coloured, tho' apparently paler than when the two metals had been dissolved by themselves.

2. A more convincing proof, that part of the platina remains suspended, after the precipitation of the gold, was obtained, by putting into the filtered liquors some plates of pure tin, which presently contracted an olive hue, and threw down a large quantity of a brownish precipitate, as from the common solutions of the crude mineral. It was observable, that the tin plates were often sensibly acted on, even whilst the liquor was overcharged with alkali.

3. It has been further suggested, and with great appearance of probability, that as a part of platina is precipitated as well as gold by alkaline salts, if only this part be mixed with gold, it will be thrown down by them again upon dissolving the compound. To determine this point, a precipitate of platina made by fixed alkali was melted with thrice its weight of fine gold, and kept in strong fusion for above an hour: they united more easily than gold does with so large a proportion of the crude mineral, and formed a smooth neat bead, which hammered well into

into a pretty thin plate before it cracked, and appeared internally uniform and equal. This compound being dissolved in aqua regia, and a fixed alkaline salt added by degrees till the acid was more than saturated, the liquor became indeed pale ; but tin plates put into it quickly discovered, that it held a very considerable quantity of platina. It appears therefore a constant property of this mineral to remain partially dissolved in the neutralised liquor ; and that minute proportions of it, mixed with gold, are by this means distinguishable.

4. Many other experiments were made of the precipitations and precipitates of gold and platina, by alkalies both of the fixed and volatile kind. The most remarkable effects were, that volatile alkalies, added to both solutions in quantity just sufficient to saturate the acid, precipitated gold entirely, but platina only in part, so much of it remaining suspended as to give the same colour to the liquor as when fixed alkalies were made use of : that, on adding a larger quantity of the spirit after the precipitation of the gold, the liquor became yellow, a part of the metal being taken up again ; and that the platina was more copiously redissolved, the liquor becoming of a deep brownish red : that the washed precipitates of both metals, whether made by volatile or fixed alkalies, proved soluble, by moderate digestion, in spirit of salt ; those of platina much more difficultly and sparingly than those of gold.

3. *By inflammable Liquors.*

1. Inflammable spirits, which revive gold from its solutions in form of yellow films, have no such effect

on solutions of platina. This experiment affords not only a criterion for distinguishing with certainty whether gold has been debased by platina, but likewise an infallible means of recovering it perfectly pure from any admixture of that mineral. If the compound be dissolved in aqua-regis, the solution mingled with twice its quantity or more of the spirit, and the mixture suffered to stand for some days in a glass slightly covered ; the whole of the gold arises to the surface, leaving the whole of the platina dissolved. The golden pellicles may be collected, by pouring the matter into a filter just large enough to contain it. The dissolved platina passes thro', leaving the gold upon the paper, which is to be washed with fresh parcels of water till the liquor runs colourless. The paper is then to be carefully squeezed together, and burnt in a crucible previously lined with vitrefied borax : when fully funk down, a little fresh borax is to be injected, and the fire raised to melt the gold. The use of lining the crucible with borax is to prevent any moleculæ of the gold from lodging in its cavities.—This process is attended with one inconvenience, the slowness of the separation of the gold from the solution : this may be in some measure expedited by employing a spirit, which has been distilled from vegetables, that give over an essential oil.

2. As essential oils take up gold from aqua-regis, and keep it dissolved for a time upon the surface of the acid ; a pure colourless oil, that of rosemary, was poured into about half its quantity of a solution of platina, the mixture well shaken, and suffered to rest : the oil quickly arose, without taking up any thing from the platina, or receiving any colour : the acid liquor

liquor underneath remained coloured as at first. Compositions of platina and gold being dissolved in aqua-regis, and treated in the same manner, the whole of the gold was imbibed by the oil, and the whole of the platina remained dissolved in the acid. The oil, loaded with the gold, appeared of a fine yellow colour, and, on standing for a few hours, threw off great part of its contents, in bright yellow films, to the sides of the glass. Sundry other distilled oils were made trial of, with the same event. The gold is easily recovered, by setting the oil on fire ; and, when thoroughly burnt out, melting the residuum with borax, as in the preceding experiment. After the separation of the oil employed at first, it may be proper, for the greater security, to add a little more ; which, if any part of the gold should happen to have been left in the liquor, will effectually take it up.

3. The experiment was repeated likewise with the subtle fluid, prepared from vinous spirits with the vitriolic acid, called by the chemists æther. The separation succeeded in the same manner as before ; the æther receiving nothing from pure platina, but instantly taking up the gold from a mixture of the two. It is observable, that the gold imbibed by this fluid is kept permanently dissolved by it ; without separating or reviving, as it does from the common essential oils and vinous spirits.

4. The liquors remaining in these experiments, after the extraction of the gold, appear on all trials the same with the common solutions of platina ; and readily betray their being impregnated with that mineral by their colour, by the precipitation with

tin, by their yielding a sparkling red precipitate with volatile spirits, &c. A far more minute proportion of platina, mixed with gold, is more distinguishable by these processes, than by those with alkaline salts above-mentioned ; these exhibiting the whole of the platina dissolved by itself, those only a part of it.

4. *By metallic Solutions.*

All the metals, which precipitate gold from aqua-regia, have been already shewn to precipitate platina also. As gold is thrown down by some metallic solutions, as well as by the metals in substance, particularly those of mercury and iron, it remains to apply these liquors as precipitants for platina.

1. A saturated solution of mercury in aqua-fortis, which readily and totally threw down gold in its metallic form, being added to a solution of platina, the liquor became immediately turbid, and, on standing for a little time, nearly the whole of the platina fell to the bottom. A solution of mercury in the marine acid, or of corrosive sublimate, likewise precipitated platina, but less perfectly, and with this difference, that the former precipitate was of a greyish brown colour, the latter of a sparkling red.

2. Solutions of iron in the vitriolic acid, or of common green vitriol in water, which totally threw down gold, happily made no change in solutions of platina. Compositions of platina and gold being dissolved in aqua-regis, the solutions diluted with about twice their quantity of water, and a filtered solution of the vitriol gradually added ; the mixtures instantly grew turbid, and, on standing, deposited the gold in form

form of a purplish grey calx, the whole of the platina remaining dissolved. It appeared, on numerous repetitions of this experiment, that no part of the platina was precipitated along with the gold, nor any of the gold kept suspended with the platina. Where the quantity of the mixt to be assayed was very small, the precipitation was usually performed in a filter, that the gold, which separates in very minute moleculæ, some of which might possibly remain unobserved in the bottom of a glafs, might be detained on the paper. The colourless sorts of filtering-paper are preferable for this use to the coloured ; as these last may be impregnated with astringent matter, which would extricate some of the ferruginous part of the vitriol. The vitriol was dissolved in about six times its quantity of water, and a few drops of oil of vitriol added, to prevent the separation of any of its iron in the filter. This solution was put into the filter first, the solution of gold and platina immediately poured into it, the whole stirred together with a clean glass rod, and such part of the liquor, as had run thro' before they had been duly mixed, poured back to the rest. The gold remaining in the filter was washed with fresh parcels of water, the paper cautiously rolled up, and burnt in a crucible, as mentioned in a former experiment.

3. Solutions of the vitriol, recommended by Kunkel and others for precipitating gold of an uncommonly high colour, made no change in the solutions either of gold or platina. The bluish green did indeed precipitate the gold ; not as blue vitriols, but by virtue of the ferruginous matter, of which these kinds largely participate. White vitriol was likewise

made trial of, but without producing any sensible effect in either solution.

4. The experiments with green vitriol were repeated on the solutions of platina and gold made in spirit of salt. The event was the same as with those made in aqua-regis ; the gold being constantly precipitated, and the platina remaining dissolved.

R E M A R K S.

It may be proper to observe, that by the processes here pointed out, the gold is purified from other metallic admixtures at the same time that it is separated from platina ; the inflammable spirits reviving, essential oils and æther imbibing, and green vitriol precipitating, gold alone. Care should be had, that the piece of the mixt, taken for examination, be totally dissolved before any trials are made with the solution ; the menstruum not acting with equal facility on the two metals, but dissolving the gold more readily than the platina. Where the acid has been dilute, and only a gentle heat applied, great part of the gold has appeared to be taken up before the platina was considerably acted on. Where the filter, with the gold in it, is burnt in the crucible, borax is the most commodious flux : but as this salt gives a sensible paleness to gold, a little nitre may be injected, after the metal has come into fusion, to restore its colour. If the nitre was added at first, whilst the gold continues subtilely divided, some particles of the metal would be dissipated during the deflagration, which that salt produces with the coaly remains of the paper.

As

As the foregoing experiments exhibit platina and gold dissolved in a mineral fluid, which by simple mechanic agitation rejects the one and retains the other, and which discovers this different appetite of union so much the more remarkably, as the two metals have been the more intimately combined : — as they further exhibit platina dissolved in liquors incapable of holding gold suspended, — gold dissolved in liquors incapable of holding platina suspended, --- gold totally precipitated by substances, which precipitate no particle of platina, --- and gold, when mixed *per minima* with platina, perfectly recovered from it by these means, without increase as well as without diminution : --- it follows, that platina is not, as some believe, gold naturally debased by the admixture of some other metallic body, but a metal of a peculiar kind, essentially different from all the others. Before the discriminating characters of platina were discovered, such a notion was highly plausible, and direct experiment seemed to confirm it : a portion of the platina might be separated in the process ; a quantity of gold mixed with the remainder, in order to collect the gold supposed to be contained in it ; the mixture submitted to operations, which gold alone was supposed capable of withstanding ; and the augmentation, which the noble metal still retained, held to be true gold gained from the platina.

The methods of trial above related will, it is presumed, be sufficient to undeceive those, who may have been imposed upon by such appearances, and betrayed into the practice of unintended frauds : to convince them, that all they have gained from platina, after the most laborious attempts to divest it of its

its imaginary coat, is no other than platina still : and, which is of more extensive utility, to distinguish all the abuses, that may be made with this metal, and restore the gold, so debased, to its original purity and value.

XXI. An Account of the Temple of Serapis at Pozzuoli in the Kingdom of Naples : In a Letter to John Ward, LL.D. and R.S. Vice-Præf. by the Rev. John Nixon, M.A. F.R.S.

S I R,

Read Mar. 17.
1757. **B**EFORE we enter upon a more particular consideration of this noble piece of antiquity, it may not be improper to premise the general account (and indeed the only one I have met with yet published), which is given of it by Mess. Cochin and Bellicard, in a little (1) treatise printed at Paris in 1755. These gentlemen acquaint us, that in 1749 there were only three pillars of this building visible, and that they were buried half way within the ground : but that soon after, workmen being employed by order of the King of the Two Sicilies to dig at the place, they came to the pedestals of those pillars ; and at length discovered the building to have been a temple, which

(1) Observations sur les Antiquités d'Herculaneum, &c. p. 82.
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